
Five New Species of the Endemic Hawaiian Genus *Cyanea* (Campanulaceae: Lobelioideae)

Thomas G. Lammers

Department of Biology and Microbiology, University of Wisconsin Oshkosh, Oshkosh,
Wisconsin 54901, U.S.A. lammers@uwosh.edu

ABSTRACT. Five new species of *Cyanea* (Campanulaceae: Lobelioideae) are described from the Hawaiian Islands, U.S.A. The first, *C. magnicalyx* Lammers (West Maui), is a member of the *C. grimesiana* complex, related to *C. cylindrocalyx* (Rock) Lammers. *Cyanea duvalliorum* Lammers & H. Oppenheimer and *C. maritae* Lammers & H. Oppenheimer (East Maui) resemble *C. magnicalyx* in their parted or divided adult leaves and might seem to belong likewise to the *C. grimesiana* complex; however, other characters suggest these two novelties are actually related to *C. scabra* Hillebrand and *C. mceldowneyi* Rock in the *C. scabra* complex. *Cyanea minutiflora* Lammers and *C. pseudofauriei* Lammers (Kaua'i) are newly segregated from *C. fauriei* H. Lévillé, which is here lectotyped and treated as a synonym of *C. coriacea* (A. Gray) Hillebrand; the former novelty has the smallest flowers in the genus.

Key words: Campanulaceae, *Cyanea*, Hawaiian Islands, Lobelioideae.

Cyanea Gaudichaud (including *Rollandia* Gaudichaud) is a genus of woody Lobelioideae (Campanulaceae) endemic to montane wet or mesic forests of the Hawaiian Islands. It is distinguished from the related genera *Clermontia* Gaudichaud and *Delissea* Gaudichaud by its combination of unbranched or sparingly branched habit, 4- to 45-flowered racemose inflorescences, chartaceous or coriaceous leaves, typically bracteolate pedicels, corollas that are dorsally cleft to about the middle, relatively small thin-walled berries, and smooth or minutely papillose dark seeds (Lammers, 1990a, 1991; Buss et al., 2001). The genus has been divided into three (Hillebrand, 1888; Wimmer, 1943; St. John, 1969) or five (Rock, 1919) sections, but neither classification is congruent with a recent molecular phylogeny (Givnish et al., 1994, 1995).

The most recent taxonomic treatment of *Cyanea* is the account contributed (Lammers, 1990a) to the *Manual of the Flowering Plants of Hawai'i*, in which 52 species were recognized. Since that time, the genus has been enlarged by its merger with

Rollandia, the resurrection of species synonymized in or omitted from the *Manual*, and the description of new species (Lammers, 1992, 1996, 1998a, 1999; Lammers & Lorence, 1993; Lammers et al., 1993). In this paper, five more species are described as new, bringing the total number of species in *Cyanea* to 77.

A note on measurements is warranted. Several specimens examined and cited here consist of both standard herbarium sheets and jars of liquid-preserved material; these are labeled in accordance with Article 8.3 of the *International Code of Botanical Nomenclature* (ICBN; Greuter et al., 2000). However, all measurements reported herein were derived solely from dried material, for the sake of consistency with earlier studies based solely on standard herbarium specimens.

ANOTHER SEGREGATE OF *CYANEA GRIMESIANA*

In my previous account of *Cyanea* (Lammers, 1990a), *C. grimesiana* Gaudichaud subsp. *grimesiana* was construed quite broadly, encompassing all populations of the species on Moloka'i, Lāna'i, and Maui, as well as those in the Ko'olau and northern Wai'anae Mountains of O'ahu. In a subsequent revision of *C. grimesiana* (Lammers, 1998a), plants of subspecies *grimesiana* from Lāna'i and most of those from Moloka'i were segregated as *C. munroi* (Hosaka) Lammers, while those from Maui were segregated as *C. mauiensis* (Rock) Lammers. At the same time, *C. grimesiana* subsp. *cylindrocalyx* (Rock) Lammers of Hawai'i was elevated to species rank as *C. cylindrocalyx* (Rock) Lammers, while *C. grimesiana* subsp. *obatae* (H. St. John) Lammers of the southern Wai'anae Mountains of O'ahu was maintained.

Since that revision, a few specimens from West Maui have been examined, which are referable to the *C. grimesiana* complex but lack the distinctive features of *C. mauiensis*: campanulate hypanthium rounded or truncate at base, corolla 7.5–12 times longer than the hypanthium with lobes as long as the tube or longer, and dorsal anthers 15–16 mm long. Instead, these plants resemble *C. cylindro-*

calyx, *C. grimesiana*, and *C. munroi* in their obconic hypanthium attenuate at base, shorter corolla (only 6.5 times longer than the hypanthium) with dorsal lobes shorter than the tube, and shorter anthers (9.5–12 mm long). However, the West Maui plants cannot be referred to any of these three species (none of which occur on Maui) as they differ in diverse ways. From *C. grimesiana* (O'ahu and Moloka'i), they differ in having the upper portion of the lamina less deeply cut (cleft or parted vs. divided), the calyx lobes longer (36–44 vs. 3–30 mm), and the dorsal corolla lobes nearly as long as the tube (vs. $\frac{1}{3}$ – $\frac{2}{3}$ as long). From *C. munroi* (Moloka'i and Lāna'i), they differ in having the calyx lobes erect from base (vs. spreading at base before curving upward), the laterally compressed corolla tube tallest at base (vs. at or near middle), and the surfaces of the anther tube glabrous (vs. pubescent at base).

Of these species, *C. cylindrocalyx* of the Waipi'o Valley of Hawai'i seems most similar to the plants of West Maui. In both, the upper portion of the lamina is pinnately parted or cleft and 2–4.5 cm wide between the segments (vs. pinnately divided and 0.2–3.2 cm wide between the segments in the other species), and the dorsal corolla lobes are $\frac{3}{4}$ as long as the tube to almost as long (vs. $\frac{1}{3}$ – $\frac{2}{3}$ as long). However, the West Maui plants differ from *C. cylindrocalyx* in their pinnae separated by sinuses (vs. overlapping), longer hypanthium (10–15 vs. 8–10 mm), distinct overlapping calyx lobes 36–44 mm long (vs. basally connate and 20–27 mm), and anther tube with all five anthers apically tufted (vs. the ventral two only). The West Maui plants are distinct from all other elements of the *C. grimesiana* complex, and are here accorded specific rank.

Cyanea magnicalyx Lammers, sp. nov. TYPE: U.S.A. Hawaiian Islands: West Maui, Honokōhau drainage basin, 25 Sep.–17 Oct. 1917, C. N. Forbes 434.M (holotype, BISH; isotype, NY). Figure 1.

Species ex affinitate *Cyaneae grimesianae*, sed a *C. grimesiana* lamina versus apicem partita vel fissa, calycis lobis 36–44 mm longis, et corollae lobis dorsalibus longitudine tubum fere aequantibus; a *C. cylindrocalyx* laminae pinnis nonsuperpositis, pedicellis 33–36 mm longis, hypanthio 10–15 mm longo, calycis lobis 36–44 mm longis distinctis et superpositis versus basim apice acuminatis, et omnibus antheris penicillatis ad apicem; a *C. mauiensis* hypanthio obconico basi attenuato, calycis lobis 36–44 mm longis 7–13 mm latis distinctis et superpositis versus basim, corolla glabra hypanthio 6.5 plo longiore, et antheris dorsalibus 9.5–12 mm longis; et a *C. munroi* calycis lobis rectis et erectis, corollae tubo basi latissimo, et antherarum tubo glabro distinguenda.

Shrubs, 1.5–3 m tall; stems branched from base, ca. 1.3 cm diam. Lamina elliptic, 36–55 cm long, 19–27 cm wide across the segments, 0.4–4.5 cm wide between the segments; upper surface green, glabrous; lower surface light green, glabrous; margin pinnately cleft or parted toward apex, pinnately compound toward base; segments narrowly oblong or narrowly triangular, 8–15 × 1.8–5 cm, 9 or 10 per side, separated by sinuses, the margin callose-serrate or shallowly lobed (the lobes shallowly deltate or shallowly triangular, 5–12 × 6–17 mm, acuminate and apiculate at apex); apex acuminate, apiculate; petiole 12–21 cm long, 3.5–6 mm diam., $\frac{1}{3}$ – $\frac{1}{2}$ as long as the lamina, glabrous, muricate. Racemes 6- to 15-flowered; peduncle ascending, 35–55 mm long, 2.2–4 mm diam., glabrous, sparsely muricate; rachis 14–25 mm long, glabrous; bracts linear or lanceolate, 14–25 × 2.5–4 mm, subtending the pedicels, sometimes a few empty ones on the peduncle, long persistent, acuminate at apex; pedicels ascending, 33–36 mm long, 1.2–1.3 mm diam., ebracteolate, glabrous. Hypanthium obconic, 10–15 mm long, 7–9 mm diam., $\frac{1}{6}$ as long as the corolla, glabrous, the base attenuate; calyx lobes ovate, lanceolate, or oblong, 36–44 × 7–13 mm, distinct, overlapping at base, erect from base, glabrous, the margin entire, acuminate and apiculate at apex; corolla yellowish white, longitudinally striped with purple, 65–70 mm long, glabrous; corolla tube laterally compressed, 35 mm long; dorsal corolla lobes 32 mm long; filament tube 55 mm long, 1 mm diam., glabrous; anther tube suberect, 2.8–3.2 mm diam., all 5 anthers with tufts of hairs 4–5 mm long at apex, the surfaces glabrous; dorsal anthers 9.5–12 mm long, $\frac{1}{5}$ – $\frac{1}{4}$ as long as the filament tube; ventral anthers 8–9 mm long. Mature fruit and seeds not seen.

Additional illustration. Lammers (1990a), pl. 53, upper right (lower inset) [as *C. grimesiana* subsp. *grimesiana*].

Distribution, habitat, and phenology. Endemic to West Maui in the Hawaiian Islands, in mesic forest at ca. 450 m elevation. Flowering during September and October. Both this species and its relative *C. mauiensis* have been collected in Olowalu Valley, the former by C. N. Forbes (see below), the latter by W. Hillebrand (cf. Lammers, 1994, 1998a).

The currently recognized taxa that comprised *C. grimesiana* as formerly circumscribed (Hillebrand, 1888; Rock, 1919; Wimmer, 1943; Lammers, 1990a) may be distinguished using the following key. It may be inserted into the most recent key to

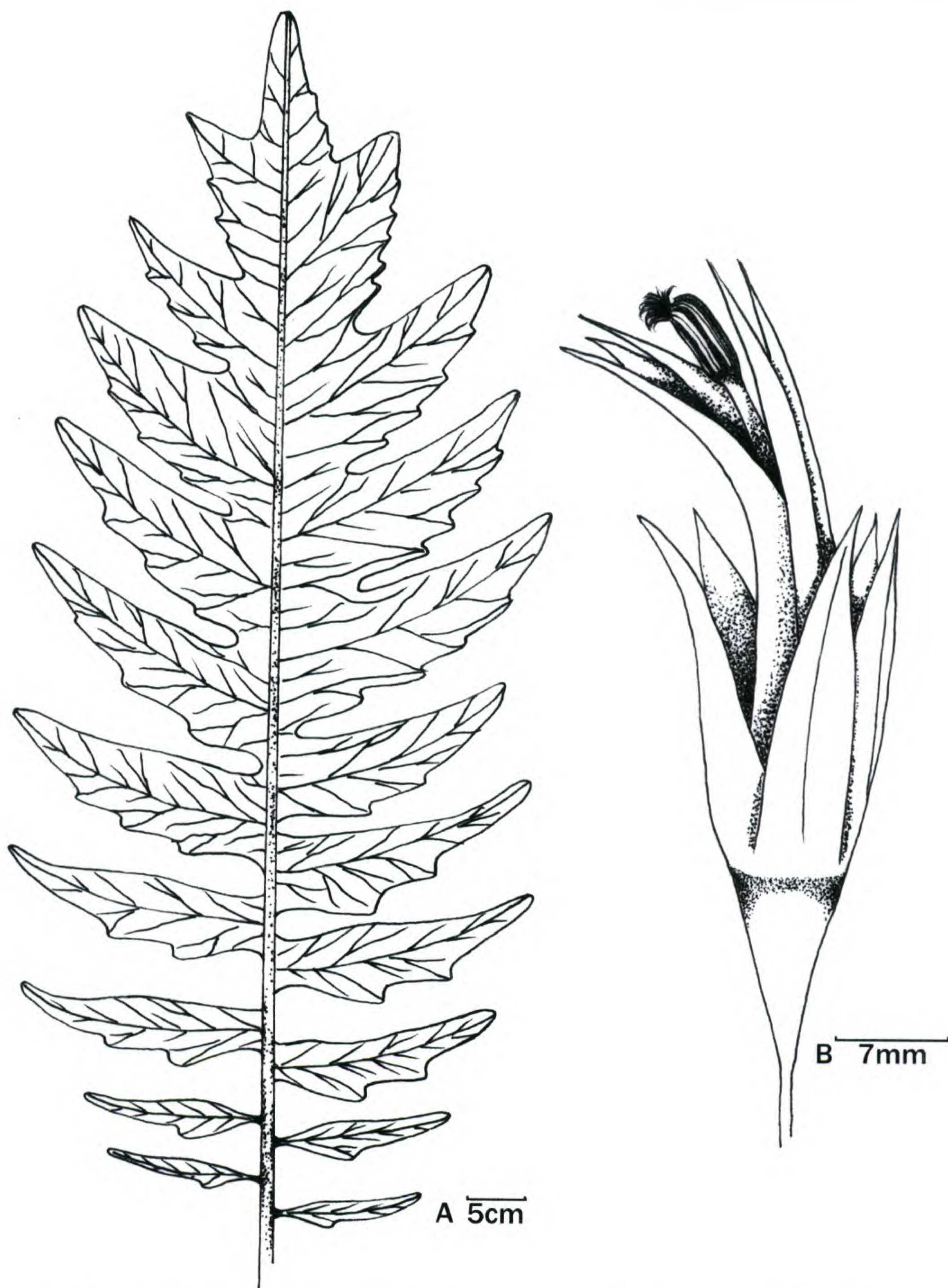


Figure 1. *Cyanea magnicalyx* Lammers. —A. Leaf. —B. Flower. (Drawn from the holotype, *Forbes 434.M.*)

the genus (Lammers, 1990a) following the first statement in couplet 47 on p. 443.

KEY TO THE SPECIES OF THE HAWAIIAN *CYANEA GRIMESIANA* COMPLEX

1a. Hypanthium campanulate, the base rounded or

truncate; corolla 7.5–12 times longer than hypanthium, the dorsal lobes 35–40 mm long, as long as the tube to half again as long; dorsal anthers 15–16 mm long, ventral 12–14 mm long (West and East Maui) *C. mauiensis*
1b. Hypanthium obconic, the base attenuate; corolla

- 4–7.5 times longer than hypanthium, the dorsal lobes 15–32 mm long, $\frac{1}{3}$ as long as the tube to about as long; dorsal anthers 9.5–14 mm long, ventral 7.5–10 mm long.
- 2a. Calyx lobes spreading at base before curving upward; corolla tube tallest at or near middle, tapering toward both apex and base, strongly arcuate; base of anther tube pubescent (Moloka'i, Lāna'i) *C. munroi*
- 2b. Calyx lobes erect from base or nearly so; corolla tube tallest at base, tapering toward the apex, curved or somewhat arcuate; base of anther tube glabrous.
- 3a. Upper portion of lamina pinnately divided, 0.2–1.5 cm wide between the segments; dorsal corolla lobes $\frac{1}{3}$ – $\frac{2}{3}$ as long as the tube.
- 4a. Segments of the lamina narrowly elliptic, narrowly oblong, or narrowly triangular; calyx lobes linear or narrowly triangular, 3–13 \times 1–2 mm, separated at base by narrow sinuses; anther tube 2.5–3.2 mm diam. (S Wai'anae Mts. of O'ahu) *C. grimesiana* subsp. *obatae*
- 4b. Segments of the lamina lanceolate or rarely narrowly elliptic; calyx lobes ovate or lanceolate, 15–30 \times 4–10 mm, overlapping at base; anther tube 3.5–4.5 mm diam. (Ko'olau and N Wai'anae Mts. of O'ahu, Moloka'i) *C. grimesiana* subsp. *grimesiana*
- 3b. Upper portion of lamina pinnately parted or cleft, 2–4.5 cm wide between the segments; dorsal corolla lobes $\frac{3}{4}$ as long as the tube to almost as long.
- 5a. Adjacent segments of the lamina separated by sinuses; pedicels 33–36 mm long; hypanthium 10–15 mm long; calyx lobes 36–44 mm long, distinct but overlapping at base, the apex acuminate; all five anthers pubescent at apex (West Maui) *C. magnicalyx*
- 5b. Adjacent segments of the lamina overlapping; pedicels 19–28 mm long; hypanthium 8–10 mm long; calyx lobes 20–27 mm long, connate at base for 7–25 mm, the apex acute or obtuse; only the two ventral anthers pubescent at apex (Waipi'o Valley of Hawai'i) *C. cylindrocalyx*

Paratypes. U.S.A. Hawaiian Islands. West Maui. **Lahaina:** Honokōhau drainage basin, *Forbes 409.M* (A, BISH, P, US); central ridge of Olowalu Valley, *Forbes 2350.M* (BISH), *Forbes 2429.M* (BISH). **Wailuku:** 'Īao Valley, *Hobdy & Sylva 1711* (BISH); canyon E of 'Īao Needle, *Hobdy 2052* (BISH); gulch E of 'Īao Needle, *Lammers, Kepler & Ecton 5579* (BISH, F, OS); Waikapū Valley, *Rock 10265* (BISH); Waihe'e Valley, Sep 1918, *Rock s.n.* (BISH).

TWO NEW SPECIES ALLIED TO *CYANEA SCABRA*

On 2 January 2000, a party of Hawaiian naturalists was enjoying a casual hike on windward East Maui. Fern Duvall, Renate Gassmann-Duvall, Hank Oppenheimer, and Marita Lewis were exploring a complex system of trails below Waikamoi Flume Road. At about 855 m above sea level, their trail came to a dead end where Wai'ohiwi Stream flowed along the base of a small steep hill. Across the stream, Gassmann-Duvall spotted several individuals of a tall arborescent *Cyanea* with dissected leaves. During subsequent visits, additional plants were discovered in the vicinity that were similar but shorter and shrubby. A third *Cyanea* with dissected foliage was also collected, approximately 100 m away from the other two. Though specimens of this last plant (e.g., *Oppenheimer & Duvall H10006*, BISH, OSH, PTBG) were readily identified as a known species, *C. aspleniifolia* (H. Mann) Hillebrand, the identity of the first two remained problematic.

Specimens of both unknowns were forwarded to me for identification. The first step was to ascertain whether the shrubs and trees represented one species or two. Developmentally related variation in vegetative morphology is not uncommon in *Cyanea* (Carlquist, 1974; Lammers, 1990a, 1990b; Givnish et al., 1994, 1995), and it was conceivable that the two gatherings represented juvenile and adult stages of a single species. The shrubs and the trees do have a number of features in common, most conspicuously their prickly stems and herbage; pinnately parted or divided adult leaves; oblong floral bracts and calyx lobes; relatively large white flowers with a stout arcuate laterally compressed corolla tube that is tallest above the middle; and orange berries crowned by the persistent calyx lobes. However, the two could be distinguished consistently by numerous features besides habit, including branching pattern, details of the leaf margin, length of the petiole, size of the bracts and floral organs, staminal pubescence, and fruit size (see key below for details). On this basis, the trees and shrubs were judged to represent two distinct species rather than developmental stages of one species. This conclusion was supported by discovery of the actual juvenile plants of both, which differed profoundly in leaf morphology from each other.

The second step was to determine if either gathering could be referred to any species included in the most recent treatment of the genus (Lammers, 1990a) or recognized subsequently (Lammers, 1992, 1996, 1998a, 1999; Lammers & Lorence, 1993; Lammers et al., 1993). Leaf dissection is an

unusual character in *Cyanea*, found in only a few species. Dissection of the adult lamina for its entire length and for more than half the distance to the midrib is found in even fewer: *C. aspleniifolia* (West and East Maui) and its ally *C. shipmanii* Rock (windward Mauna Kea on Hawai'i); *C. horrida* (Rock) O. Degener & Hosaka (East Maui); *C. pinnatifida* (Chamisso) E. Wimmer (Wai'anae Mts. of O'ahu); and *C. grimesiana* and its recent segregates *C. cylindrocalyx*, *C. magnicalyx*, *C. mauiensis*, and *C. munroi* (see above).

Of these, *C. aspleniifolia*, *C. horrida*, *C. pinnatifida*, and *C. shipmanii* certainly do not match nor even much resemble either of the Wai'ohiwi species in floral morphology. All four have corolla tubes that are terete (vs. laterally compressed), of approximately equal height throughout (vs. tallest above the middle), and (except for *C. horrida*) relatively slender and suberect or only slightly curved (vs. stouter and strongly arcuate). *Cyanea grimesiana* and its allies, on the other hand, do have stout arcuate laterally compressed corolla tubes tallest above the middle, similar to those seen in the plants from Wai'ohiwi Stream. However, none of the known members of that complex matches these two species, i.e., they could not be identified using the key above. For these reasons, the two species discovered at Wai'ohiwi Stream were judged to be undescribed. The arborescent species is here named *C. duvalliorum*, its shrubby congener *C. maritae* (see below).

The third step was to ascertain the relationships of these novelties to other members of the genus. One might assume that *C. duvalliorum* and *C. maritae* would be referable to the *C. grimesiana* complex, as these are the only other species in the genus that combine deeply dissected adult foliage with stout arcuate laterally compressed corollas. However, *C. duvalliorum* and *C. maritae* differ from *C. grimesiana* and its allies in two rather significant features. First, the two novelties produce juvenile plants that differ conspicuously from adults in leaf outline. No such dimorphism is evident in the *C. grimesiana* complex; leaves of juveniles resemble those of adults, so far as known. Second, *C. grimesiana* and its allies (except *C. cylindrocalyx*) are unique in the genus (and unusual in the subfamily as a whole) in having trichomes at the apex of all five anthers. The two novelties bear apical trichomes only on the ventral pair of anthers.

In point of fact, there is no *a priori* reason to restrict the search for relatives of *C. duvalliorum* and *C. maritae* to species with dissected adult foliage. The available evidence suggests that deeply dissected adult foliage has evolved several times within *Cyanea* (Carlquist, 1974; Lammers, 1990a, 1990b; Givnish et al., 1994, 1995). *Cyanea aspleniifolia* and *C. ship-*

manii are related to species with toothed leaves, including *C. dunbariae* Rock and *C. profuga* C. N. Forbes (Lammers, 1990b), while the closest relative of the *C. grimesiana* complex appears to be *C. lobata* H. Mann, in which the adult leaves are merely lobed (Lammers, 1990a). For these reasons, species with non-dissected foliage must also be considered as potential relatives of the novelties.

Detailed consideration of the entire genus revealed that there are two informal species groups in addition to the *C. grimesiana* complex, which are characterized by many of the same features found in *C. duvalliorum* and *C. maritae*: frequent production of prickles; relatively well developed bracts; relatively large white flowers; corolla tubes stout, arcuate, laterally compressed, and tallest above the middle; and orange or yellow berries crowned by the persistent calyx lobes.

The first consists of the ten species formerly segregated as the genus *Rollandia* (Lammers et al., 1993; Lammers, 1998a): *C. calycina* (Chamisso) Lammers; *C. crispa* (Gaudichaud) Lammers, Givnish & Sytsma; *C. humboldtiana* (Gaudichaud) Lammers, Givnish & Sytsma; *C. koolauensis* Lammers, Givnish & Sytsma; *C. lanceolata* (Gaudichaud) Lammers, Givnish & Sytsma; *C. longiflora* (Wawra) Lammers, Givnish & Sytsma; *C. parvifolia* (C. N. Forbes) Lammers, Givnish & Sytsma; *C. purellifolia* (Rock) Lammers, Givnish & Sytsma; *C. sessilifolia* (O. Degener) Lammers; and *C. st.-johnii* (Hosaka) Lammers, Givnish & Sytsma. These plants are unique within the genus in the dorsal adnation of the filament tube to the corolla tube and further differ from the *C. grimesiana* complex in their lack of dissection of the adult foliage; margins are entire or more often merely toothed. However, this complex does show some developmental dimorphism. Four species (*C. calycina*, *C. lanceolata*, *C. longiflora*, and *C. sessilifolia*) produce distinctive juveniles, though in these the margins of the juvenile leaves are merely lobed rather than parted or divided. Biogeographically, the species of the *Rollandia* complex are all endemic to O'ahu, except for *C. parvifolia*, which is endemic to Kaua'i; no representatives occur on or near East Maui.

The second informal group consists of five species found on the two youngest islands of the archipelago: *C. glabra* (E. Wimmer) St. John, *C. longissima* (Rock) H. St. John, *C. mceldowneyi* Rock (all from East Maui), *C. platyphylla* (A. Gray) Hillebrand (windward Hawai'i), and *C. scabra* Hillebrand (West Maui). Like the *Rollandia* complex, the *C. scabra* complex differs from the *C. grimesiana* complex in its lack of dissection of adult foliage and the presence of developmental dimor-

phism. As before, the species that do produce distinctive juveniles (*C. glabra*, *C. mceldowneyi*, and *C. platyphylla*) bear leaves that are merely lobed rather than parted or divided.

The relationships of *C. duvalliorum* and *C. maritae* lie somewhere among these three informal groups. Of them, the *Rollandia* complex seems the most distantly related to *C. duvalliorum* and *C. maritae*. None of its species has leaves, adult or juvenile, that even approach the two novelties in degree of dissection, while the novelties lack the unique adnation of the staminal column that characterizes the group; furthermore, the species of the *Rollandia* complex occur three or four islands away in a very different biogeographic setting. The *C. grimesiana* and *C. scabra* complexes lack this adnation of the staminal column and are represented on East Maui.

It is more difficult to decide between the *C. grimesiana* and *C. scabra* complexes, because their distinctness is blurred to some extent by *C. duvalliorum* and *C. maritae*. Though the *C. grimesiana* complex would seem more similar to the novelties due to its dissected adult foliage, it does not show any tendency toward developmental dimorphism. This seems to me to reflect a fundamental difference in life history. Furthermore, the novelties differ from *C. grimesiana* and most of its allies in their lack of apical pubescence on the three dorsal anthers. This feature is unique to these species within *Cyanea* (and very rare in the subfamily) and seems a valuable indicator of affinity. Biogeographically, this complex is represented on East Maui by just one of its five species.

Though the *C. scabra* complex shows no dissection of the adult lamina, three of its five species do produce distinctive juveniles. In all its species, the anthers bear trichomes only on the ventral pair, as in the novelties. Furthermore, East Maui is the center of diversity for this complex, with three of its five species endemic there. Overall, *C. duvalliorum* and *C. maritae* do seem more closely related to the members of the *C. scabra* complex.

Within this complex, one would assume that the two new species are each other's closest relative, as they are the only members of the group with parted or divided adult leaves. Of the species described previously, *C. scabra* and *C. mceldowneyi* seem most closely related to the two novelties, based on their common possession of persistent narrowly oblong bracts and calyx lobes, rounded at apex (see key below).

It is noteworthy that *C. duvalliorum* possesses a feature unique in the genus: the concrescence of the apical trichomes on the ventral anthers into a triangular scale. An identical scale, formed in the

same manner, characterizes a Latin American taxon of Lobelioideae, *Centropogon* C. Presl subg. *Centropogon* (Lammers, 1998b). Like the branched trichomes found in *Cyanea calycina* and *Centropogon* sect. *Siphocampyloides* Benth (Lammers, 1998b, 2002; Batterman & Lammers, in press), this is apparently a case of parallel evolution.

Although the plants discovered at Wai'ohiwi Stream could not be equated with any named species, they do appear to match a number of specimens collected on East Maui by earlier botanists. These specimens were sterile or otherwise inadequate for confident identification, and languished in herbaria under various names for many years.

Of these earlier specimens, *Rock 8797*, *8797a*, and *8798* served as paratypes of *C. scabra* var. *variabilis* Rock. Although these gatherings are referable to *C. duvalliorum* (8797) and *C. maritae* (8797a, 8798), the holotype of *C. scabra* var. *variabilis* is a specimen of *C. longissima* and that name is properly treated as a synonym of this species. Previously (Lammers, 1990a), all these paratypes were regarded as juveniles of *C. glabra*. However, I subsequently realized that the leaf margin of true juvenile *C. glabra* (e.g., *Forbes 1657.M*, BISH, K, L, RSA, S) is only shallowly lobed, not deeply dissected.

The remainder of the early sterile collections of *C. duvalliorum* had been identified tentatively as *C. horrida*. Though these two species are very similar in morphology of both juvenile and adult leaves, sterile specimens may be distinguished on the basis of pubescence. In *C. horrida*, the leaves are sparsely pubescent adaxially and more densely so abaxially; in *C. duvalliorum*, pubescence is confined to the abaxial venation or totally absent.

These earlier collections considerably extend the distributional range of both *C. duvalliorum* and *C. maritae* on the windward slopes of Haleakalā. Some were collected 7–12 km east of Wai'ohiwi Stream, from Honomanū Stream to Wailua Iki Stream; others were obtained approximately 25 km east, at Kīpahulu Valley. Efforts should be made to ascertain whether any of these populations is still extant.

Cyanea duvalliorum Lammers & H. Oppenheimer, sp. nov. Type: U.S.A. Hawaiian Islands: East Maui, Makawao District, Ko'olau Forest Reserve, Wai'ohiwi, 20°50'04"N, 156°15'55"W, mesic forest, steep shady slope, 2800 ft., 15 Oct. 2000, *H. Oppenheimer & F. Duvall H100026* (holotype, BISH [sheet plus liquid]; isotypes, B, K, MO, NY, OSH, PTBG, US). Figure 2.

Species ob marginem foliorum maturorum pinnatim fis-

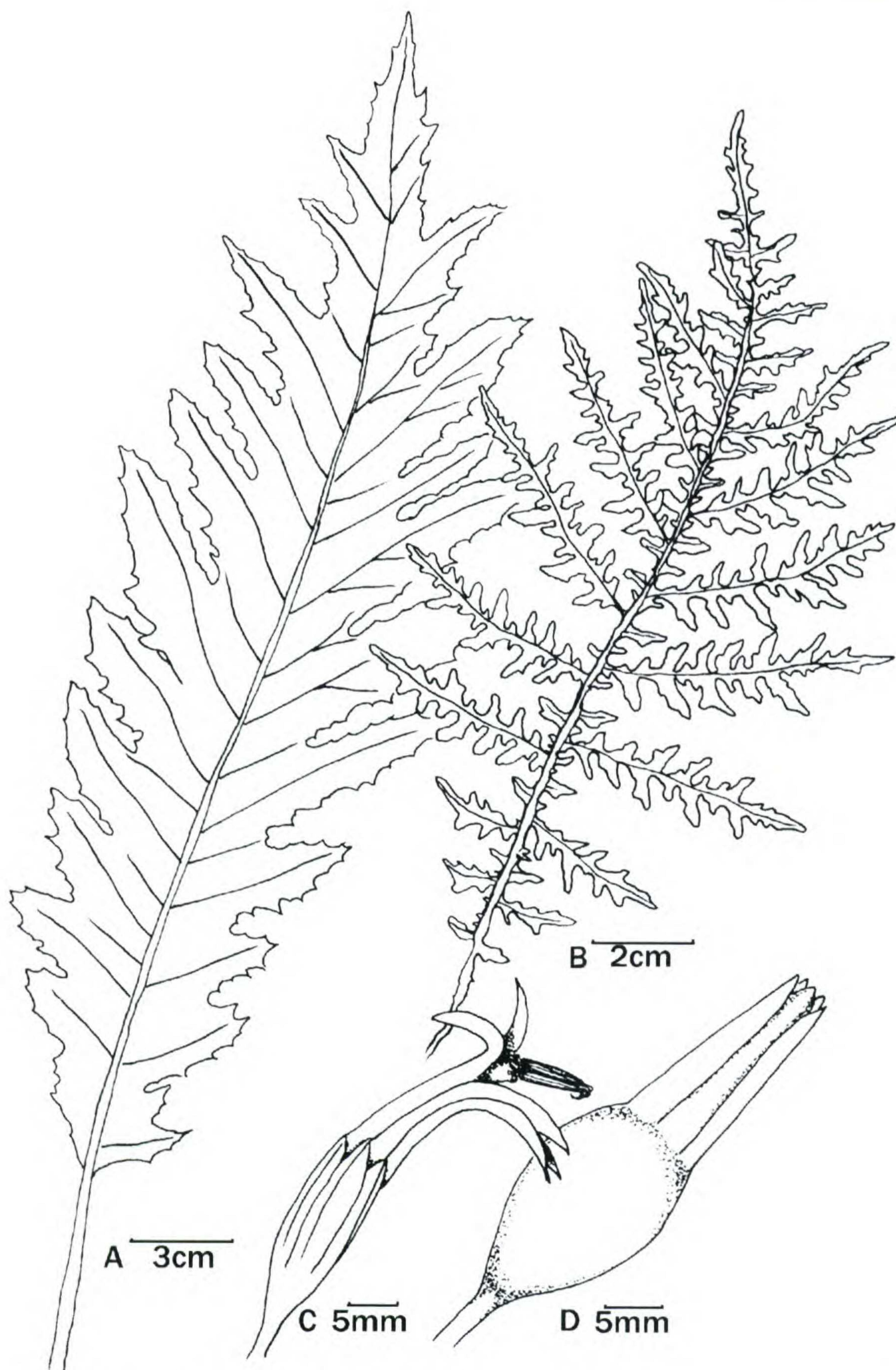


Figure 2. *Cyanea duvalliorum* Lammers & H. Oppenheimer. —A. Adult leaf. —B. Juvenile leaf. —C. Flower. —D. Fruit. (A, C drawn from the holotype, *Oppenheimer & Duvall H100026*; B, D drawn from a paratype, *Oppenheimer et al. H10003*.)

sum partitum vel divisum et corollae tubum compressum arcuatum supra medium altissimum affinitatem *Cyaneae grimesianae* simulans, sed ob plantas juveniles proprias et tubum antherarum cum trichomatibus apicalibus solum in pari ventrali gregem *C. scabrae* vero pertinet; inter *C. scabram* et species affines habitu arboreo 4–6 m alto, margine foliorum maturorum pinnatim partito vel fisso basin

versus pinnato, bracteolis longioribus 4–5 mm longis, bracteis longioribus 10–13 mm longis, calycis lobis longioribus 13–19 mm longis, corolla hypanthio triplo vel quadruplo longiore, staminali columna pubescenti, tubo filamentorum antheris dorsalibus triplo longiore, antheris dorsalibus longioribus 11–12 mm longis, antheris ventralibus ad apicem squama triangularis formata trichom-

atibus conerescentibus, et baccis longioribus 17–21 mm longis distinguenda.

Trees, 4–6 m tall, producing distinctive juveniles but these not flowering precociously; stems of juveniles 0.7–1.2 cm diam., unbranched, armed with numerous prickles consisting of a sharp trichome atop a bulbous multicellular base; stems of adults 1.6–2 cm diam. below the leaves and inflorescences, 4–21 cm diam. at base, branching about 1 m above ground, the 4 to 11 branches diverging from trunk at a 45°–60° angle, ascending, sometimes branching sparingly once again, armed with stout conic prickles below, becoming smooth toward apex, sometimes producing short shoots with juvenile foliage; latex white. *Juveniles* with lamina elliptic or oblanceolate, 13–27 cm long, 7–17 cm wide across the segments, 0.2–0.4 cm wide between the segments; upper surface dark green and glabrous; lower surface light green, glabrous, armed with prickles consisting of a sharp trichome atop a bulbous multicellular base; margin pinnately divided, becoming pinnately compound at base, the segments oblong or elliptic, 1–9 × 0.7–2.8 cm, 8 to 10 per side, separated by sinuses, their margin pinnately lobed, cleft, parted, or divided (these secondary segments oblong or narrowly triangular, 2–18 × 2–10 mm, the apex obtuse); apex obtuse; petiole 3–4 cm long, 0.2–0.3 mm diam., $\frac{1}{7}$ – $\frac{1}{3}$ as long as the lamina, armed with prickles consisting of a sharp trichome atop a bulbous multicellular base. *Adults* with lamina elliptic or oblanceolate, 31–53 cm long, 10–20 cm wide across the segments, 0.5–4.7 cm wide between the segments; upper surface dark green and glabrous; lower surface light green and pubescent on veins with short stiff curved hairs; margin pinnately parted or divided, becoming pinnately compound at base, the segments oblong or elliptic, 1.5–12.5 × 0.5–4 cm, 10 to 14 per side, separated by sinuses, their margin pinnately cleft or parted (these secondary segments deltate or triangular, 2–22 × 2–18 mm, the apex acute or acuminate); apex acute or acuminate; petiole 4.5–6.5 cm long, 3.5–9 mm diam., $\frac{1}{10}$ – $\frac{1}{8}$ as long as the lamina, minutely pubescent. Racemes 6- to 10-flowered, arising below the apical rosette of leaves, the flowers all blooming ± simultaneously; peduncle and rachis horizontal, 35–54 mm long, 4–9 mm diam., glabrous; bracts narrowly oblong, 10–13 × 1.5–1.6 mm, subtending the pedicels, sometimes a few empty ones on the peduncle, deciduous, rounded at apex; pedicels ascending, 9–14 mm long, 0.8–1 mm diam., medially or subapically bibracteolate, glabrous; bracteoles narrowly oblong, 4–5 × 0.8–1.2 mm. Hypanthium obconic,

10–12 mm long, 5–9 mm diam., $\frac{1}{5}$ – $\frac{1}{3}$ as long as the corolla, glabrous, attenuate at base; calyx lobes narrowly oblong, 13–19 × 2.6–5 mm, abutting at base but distinct, erect, glabrous, the margin entire, rounded and apiculate at apex; corolla white, 38–47 mm long, glabrous; corolla tube arcuate, laterally compressed, 23–28 mm long, 5–6 mm tall at base, narrowing gradually to 3–4 mm tall at mouth, cleft dorsally for ca. half its length; dorsal corolla lobes spreading, 16–19 × 1 mm, ca. $\frac{2}{3}$ as long as tube; ventral corolla lobes deflexed, 13–15 × 1 mm; filament tube 32–40 mm long, 1.3–1.5 mm diam., pubescent with long white hairs, free from the corolla; anther tube gently decurved, 2.3–2.7 mm diam., densely pubescent at base and on the connectives; dorsal anthers 11–12 mm long, ca. $\frac{1}{3}$ as long as the filament tube; ventral anthers 7.5–8.5 mm long, their apex crowned by a triangular scale 3–4.5 mm long, formed from loosely conerescent white trichomes. Berries bright orange, ellipsoid, 17–21 mm long, 10–15 mm diam., crowned by the persistent calyx lobes; seeds brown, broadly ellipsoid, 0.7 mm long, 0.5 mm diam., the testa Type C of Murata (1992, 1995), smooth, shiny.

Distribution, habitat, and phenology. Endemic to windward East Maui in the Hawaiian Islands. Recent fertile collections are from mesic forests on the northwestern slopes of Haleakalā in the Wai'ohiwi watershed at an elevation of 855 m; more than 50 mature trees and numerous juveniles were observed here during 2000–2002. Sterile collections were obtained from the same general region and points to the east at slightly higher elevations (1070–1522 m) in 1911, 1920, 1927, and 1980. Sterile specimens were also collected farther east, at Kīpahulu Valley, in 1919. This species flowers during October, and the fruits ripen during December and January.

Etymology. *Cyanea duvalliorum* is named for two of its discoverers, ornithologists Renate Gassmann-Duvall (b. 1946) and her husband Fern Duvall (b. 1953), who are extremely active in the Hawaiian conservation community. They have brought the new species (and others) into cultivation and taken the lead in securing its preservation.

Paratypes. U.S.A. Hawaiian Islands. East Maui. **Makawao:** above Kula pipe line, *Munro 724A* (BISH); Haleakalā pipe line, *Munro 724B* (BISH, NY, US), *G. C. Munro 725* (BISH); Ha'ikū Uka, Wai'ohiwi Stream, *Oppenheimer et al. H10003* (BISH [2 sheets plus liquid], MO, NY, OSH [sheet plus liquid], PTBG, US); Ha'ikū Uka, tributary of Wai'ohiwi Stream, *Oppenheimer et al. H10012* (BISH, OSH, PTBG); W of Ōpana Gulch across stream, *Warschauer & McEldowney 2754* (BISH). **Hāna:** ridge left Kīpahulu, *Forbes 1728.M* (BISH), *Forbes 1729.M* (BISH);

trail E of Keʻanae & up ridge between W & E Wailua Iki, *Forbes 2659.M* (BISH); Keʻanae Valley, *Rock 8797* (BISH).

Cyanea maritae Lammers & H. Oppenheimer, sp. nov. TYPE: U.S.A. Hawaiian Islands: East Maui, Makawao District, Koʻolau F. R., Waiʻohiwi drainage basin, 2800 ft., growing above the confluence of two intermittent tributaries, near the main stream, 20°50'06"N, 156°15'52"W, degraded mesic forest amidst forestry plantings of *Eucalyptus robusta* & *E. globulus*, 26 Nov. 2000, H. Oppenheimer & F. Duvall H110029 (holotype, BISH; isotypes, OSH, PTBG). Figure 3.

Species ob marginem foliorum maturorum pinnatim fissum partitum vel divisum, calycis lobum et florum bracteam oblongum, et corollae tubum arcuatum compressum affinis *Cyaneae duvalliorum*, sed ab hac specie habitu fruticoso, ramis basalibus paucioribus 2–4 valde assurgentibus, foliis juvenilibus et maturis cum segmentis triangularis serrulatis 5–8 utrobique, petiolis foliorum maturorum proportione longioribus admodum $\frac{1}{3}$ – $\frac{1}{2}$ laminam aequantibus, hypanthio proportione brevioris modum $\frac{1}{7}$ – $\frac{1}{6}$ corollam aequanti, calycis lobis brevioribus 3.5–9.5 mm longis, corolla longiore 59–61 mm longa cum lobis dorsalibus $\frac{1}{3}$ – $\frac{2}{5}$ tubum aequantibus, filamentorum tubo antheris dorsalibus quadruplo vel quintuplo longiore, et baccis parvioribus 12–13 mm longis bene distinguenda.

Shrubs, 2–2.4 m tall, producing distinctive juveniles but these not flowering precociously; stems of juveniles unbranched, armed with numerous prickles consisting of a sharp trichome atop a bulbous multicellular base; stems of adults 0.7–1.5 cm diam. toward apex, 6.3–7.4 cm diam. at base, producing 2 to 4 strongly ascending branches from near the base (sometimes unbranched), armed with stout conic prickles below, becoming smooth toward apex; latex white. *Juveniles* with lamina broadly elliptic, 6.8–15 cm long, 4.6–8.7 cm wide across the segments, 2.3–3.8 cm wide between the segments, both surfaces armed with prickles consisting of a sharp trichome atop a bulbous multicellular base; upper surface dark green; lower surface light green; margin pinnately parted; segments triangular, 0.5–2 × 0.3–1.8 cm, 5 to 8 per side, separated by sinuses, their margin minutely serrulate, acuminate at apex; apex acuminate; base truncate; petiole 2–4.7 cm long, 1.2–2 mm diam., ca. $\frac{1}{3}$ as long as the lamina, armed with prickles consisting of a sharp trichome atop a bulbous multicellular base. *Adults* with lamina 17–37 cm long, 8.5–19 cm wide across the segments, 1.3–10 cm wide between the segments, elliptic or oblong, both surfaces armed with prickles consisting of a sharp trichome atop a bulbous multicellular base; upper surface dark green; lower surface light green, glabrous or pubescent on veins with short stiff curved hairs; margin pinnately

cleft, parted, or divided; segments narrowly triangular, triangular, or deltate, or shallowly triangular, often falcate, 0.6–10 × 0.8–4.5 cm wide, 6 to 8 per side, separated by sinuses, their margin minutely serrulate, acuminate or acute and apiculate at apex; apex acuminate; base cuneate or obtuse; petiole 10–13.5 cm long, 3–4.3 mm diam., $\frac{1}{3}$ – $\frac{1}{2}$ as long as the lamina, sparsely armed with prickles consisting of a sharp trichome atop a bulbous multicellular base. Racemes 9- to 45-flowered over their lifetime, but only 4 to 8 flowers present at any given time, arising within the apical rosette of leaves; peduncle and rachis horizontal, 45–90 mm long, 2.5–4 mm diam., sparsely armed with prickles consisting of a sharp trichome atop a bulbous multicellular base; bracts oblong, 1.5–2.2 × 0.8–1 mm, subtending the pedicels, deciduous, rounded or obtuse at apex; pedicels spreading, 12–25 mm long, 0.9–1 mm diam., ebracteolate, glabrous. Hypanthium campanulate or obconic, 9–9.5 mm long, 7–9 mm diam., $\frac{1}{7}$ – $\frac{1}{6}$ as long as the corolla, glabrous, cuneate at base; calyx lobes oblong, 3.5–9.5 × 1.5–3 mm, abutting at base but distinct, erect, glabrous, the margin entire, acute or rounded and apiculate at apex; corolla white tinged with pink, 59–61 mm long, sparsely pubescent, especially on the lobes; corolla tube arcuate, laterally compressed, 42–46 mm long, 5–6.3 mm tall at base, increasing to 7–9.2 mm tall above the middle before decreasing to 3.8–5.5 mm tall at mouth, cleft dorsally for ca. $\frac{1}{2}$ its length; dorsal corolla lobes spreading, 14–18 × 1.5–2 mm, $\frac{1}{3}$ – $\frac{2}{5}$ as long as tube; ventral corolla lobes deflexed, 11–14 × 0.9–1.7 mm, connate basally for 5–6 mm; filament tube 50–51 mm long, 1.8–2.1 mm diam., glabrous, free from the corolla; anther tube gently decurved, 2.8–3.4 mm diam. at base, tapering to 1.5–2 mm diam. at mouth, glabrous; dorsal anthers 11–12.5 mm long, $\frac{1}{5}$ – $\frac{1}{4}$ as long as the filament tube; ventral anthers 8–9 mm long, their apex crowned by a tuft of white trichomes 2.5–3 mm long. Berries yellowish orange, broadly ellipsoid or obovoid, 12–13 mm long, 8.5–10.5 mm diam., crowned by the persistent calyx lobes; seeds brown, broadly ellipsoid, 0.7 mm long, 0.5 mm diam., the testa Type C of Murata (1992, 1995), smooth, shiny.

Distribution, habitat, and phenology. Endemic to windward East Maui in the Hawaiian Islands. Recent fertile collections are from mesic forests on the northwestern slopes of Haleakalā in the Waiʻohiwi watershed at an elevation of 855 m; less than 20 adult and juvenile plants were observed here during 2000–2002. Sterile specimens were collected from the same general region and points

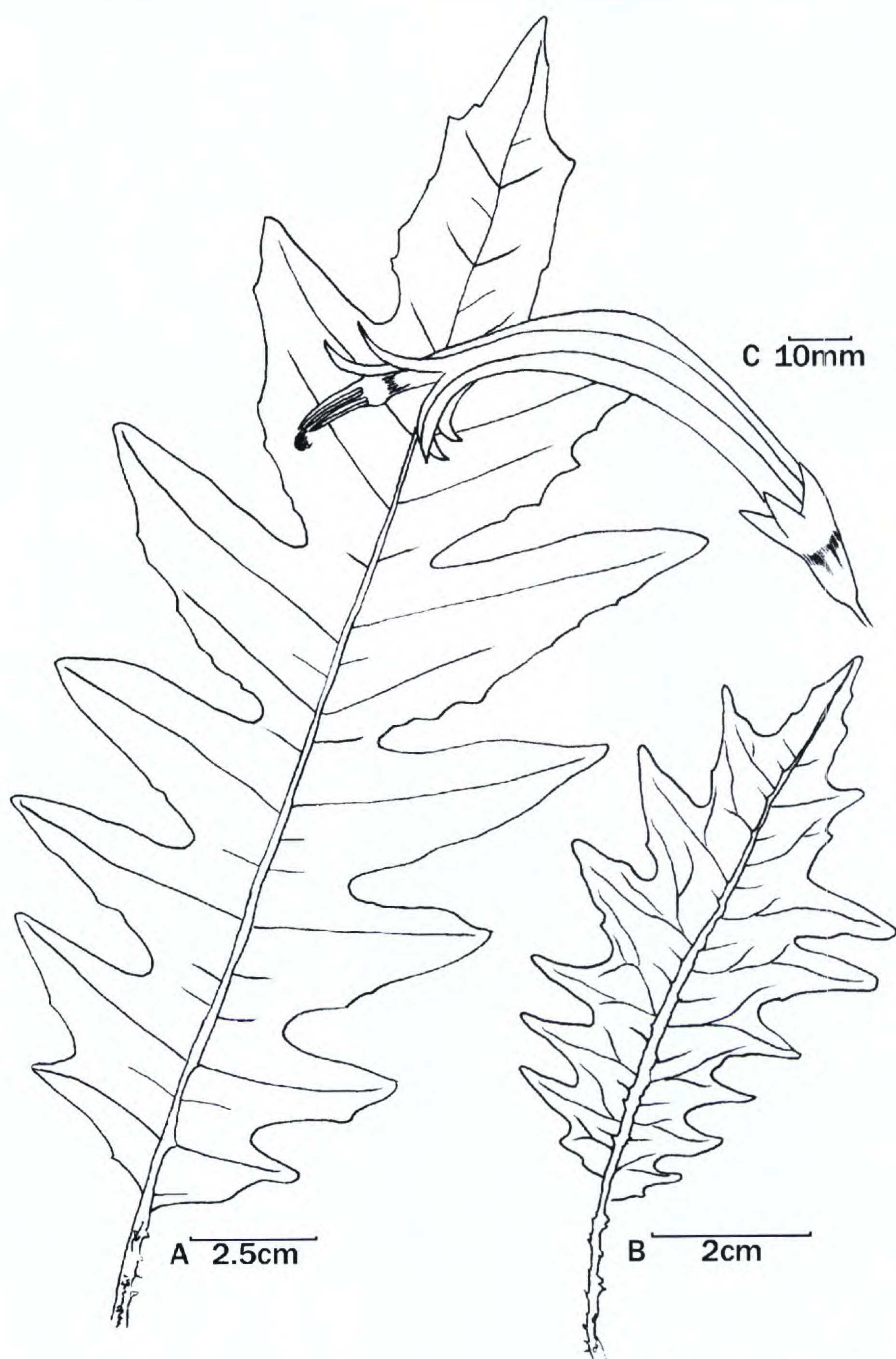


Figure 3. *Cyanea maritae* Lammers & H. Oppenheimer. —A. Adult leaf. —B. Juvenile leaf. —C. Flower. (A, C drawn from the holotype, *Oppenheimer & Duvall H110029*; B drawn from a paratype, *Oppenheimer & Duvall H10005*.)

to the east in 1911, and farther east at Kīpahulu Valley in 1919. This species flowers during November and December, and the berries ripen by May.

Etymology. This species is named in honor of one of its discoverers, Marita Oppenheimer née

Lewis (b. 1957), long-time Maui resident and avid hiker.

Paratypes. U.S.A. Hawaiian Islands. East Maui. **Makawao:** Ha'ikū Uka, Wai'ohiwi Stream, *Oppenheimer & Duvall H10005* (BISH, OSH, PTBG); Ha'ikū Uka, Wai'ohiwi

Stream, *Oppenheimer & Duvall H10005B* (BISH, K, NY, OSH, PTBG). **Hāna:** ridge left side Kīpahulu Valley, *Forbes 1636.M* (BISH), *Forbes 1680a.M* (BISH); Honomānū Valley, *Rock 8797a* (BISH, GH); Ke‘anae Valley, *Rock 8798* (BISH, GH).

The species of the *Cyanea scabra* complex as defined above may be distinguished using the following key. In the most recent key to the genus (Lammers, 1990a), this may be substituted for couplets 48–51 on p. 443.

KEY TO THE SPECIES OF THE HAWAIIAN *CYANEA SCABRA* COMPLEX

- 1a. Bracts oblong, their apex obtuse; calyx lobes oblong, their apex rounded, truncate, or emarginate, often apiculate.
- 2a. Margin of adult lamina cleft, parted, or divided.
- 3a. Trees, 4–6 m tall; stems branching at least 1 m above the base, producing 4 to 11 spreading branches; juvenile leaves with 8 to 10 oblong or elliptic segments per side, the margin of these segments lobed, cleft, parted, or divided; adult leaves with 10 to 14 oblong or elliptic segments per side, the margin of these segments cleft or parted; petiole of adult leaves 4.5–6.5 cm long, $\frac{1}{10}$ – $\frac{1}{8}$ as long as the lamina; bracts 10–13 × 1.5–1.6 mm; hypanthium $\frac{1}{5}$ – $\frac{1}{3}$ as long as corolla; calyx lobes 13–19 mm long; corolla 38–47 mm long, the dorsal lobes ca. $\frac{2}{3}$ as long as the tube; filament tube 32–40 mm long, ca. 3 times longer than the dorsal anthers, pubescent; anther tube 2.3–2.7 mm diam., densely pubescent at base and on connectives; ventral anthers tipped by a triangular scale of concrescent trichomes 3–4.5 mm long; berries 17–21 mm long, 10–15 mm diam. (East Maui) *C. duvalliorum*
- 3b. Shrubs, 2–2.4 m tall; stems branching near base, producing 2 to 4 strongly ascending branches (rarely unbranched); juvenile leaves with 5 to 8 triangular segments per side, the margin of these segments serrulate; adult leaves with 6 to 8 narrowly triangular, triangular, deltate, or shallowly triangular segments per side, the margin of these segments serrulate; petiole of adult leaves 10–13.5 cm long, $\frac{1}{3}$ – $\frac{1}{2}$ as long as the lamina; bracts 1.5–2.2 × 0.8–1 mm; hypanthium $\frac{1}{7}$ – $\frac{1}{6}$ as long as corolla; calyx lobes 3.5–9.5 mm long; corolla 59–61 mm long, the dorsal lobes $\frac{1}{3}$ – $\frac{2}{5}$ as long as the tube; filament tube 50–51 mm long, 4–5 times longer than the dorsal anthers, glabrous; anther tube 2.8–3.4 mm diam., glabrous; ventral anthers tipped by a tuft of free trichomes 2.5–3 mm long; berries 12–13 mm long, 8.5–10.5 mm diam. (East Maui) . . . *C. maritae*
- 2b. Margin of adult lamina dentate or denticulate.

- 4a. Lamina elliptic or obovate, 2.5–4.5 times as long as the petiole, the base obtuse or rounded; corolla 50–60 mm long, the tube 37–45 mm long, 3–3.8 mm tall at mouth and 4.7–7.3 mm tall near middle; filament tube 43–55 mm long; dorsal anthers 8–8.5 mm long, $\frac{1}{7}$ – $\frac{1}{5}$ as long as filament tube; ventral anthers 5.5–6.5 mm long, their apical hairs 3–3.8 mm long (West Maui) *C. scabra*
- 4b. Lamina narrowly oblong or oblanceolate, 5–9 times as long as the petiole, the base cuneate; corolla 62–65 mm long, the tube 48–51 mm long, 5.5–6.5 mm tall at mouth and 8.2–11 mm tall near middle; filament tube 56–60 mm long; dorsal anthers 5 mm long, $\frac{1}{12}$ – $\frac{1}{10}$ as long as filament tube; ventral anthers 4 mm long, their apical hairs 1.5–2 mm long (East Maui) *C. mceldowneyi*
- 1b. Bracts linear, linear triangular, or narrowly triangular, their apex acuminate; calyx lobes triangular or narrowly triangular, their apex acuminate.
- 5a. Leaf base long attenuate, narrowing imperceptibly into a winged petiole; corolla tube 45–49 mm long; dorsal anthers 5.3–6 mm long, about $\frac{1}{10}$ as long as the filament tube; ventral anthers 4.2–4.9 mm long, their apical hairs 1–1.5 mm long (East Maui) *C. longissima*
- 5b. Leaf base cuneate or obtuse, rarely rounded, the petiole not winged; corolla tube 26–45 mm long; dorsal anthers 7–10 mm long, $\frac{1}{8}$ – $\frac{1}{4}$ as long as the filament tube; ventral anthers 5–8 mm long, their apical hairs 1.7–3.5 mm long.
- 6a. Corolla 55–64 mm long, the tube 43–45 mm long, 5.5–8 mm tall at base, 9–11 mm tall near middle, the lobes $\frac{1}{4}$ – $\frac{2}{5}$ as long as the tube; filament tube 48–57 mm long; hairs at apex of ventral anthers 1.7–2 mm long (East Maui) *C. glabra*
- 6b. Corolla 43–56 mm long, the tube 26–39 mm long, 3–5 mm tall at base, 4–9 mm tall near middle, the lobes $\frac{2}{5}$ – $\frac{7}{8}$ as long as the tube; filament tube 36–50 mm long; hairs at apex of ventral anthers 2–3.5 mm long (windward Hawai‘i) *C. platyphylla*

CYANEA SECT. *DELISSEOIDEAE*

As circumscribed by Rock (1919), *Cyanea* sect. *Delisseoideae* (Hillebrand) Rock comprises those members of the genus that are shrubs or treelets 0.3–5 m tall (rarely small branched trees to 7 m tall) with stems 0.5–2.5 cm in diameter just below the apex, totally lacking prickles, with entire or toothed leaves, minute deciduous triangular bracts, bibracteolate pedicels, minute calyx lobes, hypanthium only $\frac{1}{10}$ – $\frac{1}{5}$ as long as the relatively small, slender, suberect or gently curved white corolla,

purple berries, and small minutely papillose seeds (Type F testa; Buss et al., 2001). Of the species recognized in the most recent treatment of the genus (Lammers, 1990a) and its supplements (Lammers & Lorence, 1993; Lammers, 1998a), the following are referable to section *Delisseoideae*: *C. angustifolia* (Chamisso) Hillebrand (lectotype of the section; St. John, 1969), *C. asarifolia* H. St. John, *C. coriacea* (A. Gray) Hillebrand, *C. dolichopoda* Lammers & Lorence, *C. elliptica* (Rock) Lammers, *C. fauriei* H. L  veill  , *C. habenata* (H. St. John) Lammers, *C. hardyi* Rock, *C. kahiliensis* (H. St. John) Lammers, *C. linearifolia* Rock, *C. mannii* Brigham, *C. membranacea* Rock, *C. obtusa* (A. Gray) Hillebrand, and *C. spathulata* (Hillebrand) A. Heller.

In my earlier treatment, I followed Rock (1917, 1919) in recognizing *C. coriacea* and *C. fauriei* as distinct and largely allopatric species, distinguished primarily by inflorescence length: plants of northern Kaua  i with short spreading or ascending condensed racemes were called *C. coriacea*, while plants of southern Kaua  i with long pendent elongate racemes were called *C. fauriei*. However, field studies on Kaua  i in 1991 and detailed examination of a larger body of herbarium specimens convinced me that many of the long-racemed plants I had identified as *C. fauriei* were otherwise indistinguishable from *C. coriacea*. Variation in raceme length among these plants is continuous and essentially clinal. In northern Kaua  i (e.g., on the N  pali Coast) are found populations with relatively short often ascending racemes (cf. Rock, 1919, pl. 109). These lengthen as one proceeds south, reaching their greatest development with the highly elongate and pendent racemes found in Olokele Canyon (cf. Rock, 1919, pl. 110). It is worth noting that Rock himself had earlier (Rock, 1913, 1914) treated the two names as synonymous, while Wimmer (1943) treated *C. fauriei* as a variety of *C. coriacea*, a classification embraced by Degener and Degener (1956) and St. John (1973, 1980).

However, not all specimens that I had identified as *C. fauriei* resemble *C. coriacea*. Many of the plants with relatively long pendent racemes differ from *C. coriacea* in a number of characteristics, including slimmer twigs and smaller leaves. In these features, they more closely resemble *C. hardyi*; in fact, some of these specimens were previously identified as that species. However, these smaller-leaved plants differ from *C. hardyi* in several features, including their broader leaf base, shorter rachis and pedicels, shorter hypanthium and calyx lobes, and shorter filament tube. Furthermore, one specimen previously identified as *C. fauriei* differs

from all these plants in its extremely small flowers, e.g., hypanthium only 2.3–2.7 mm long, corolla just 15–16.5 mm long, filament tube 12–14 mm long, and anthers (dorsal pair) 4.5–5 mm long. In fact, these are the smallest known flowers in the entire genus, by a significant margin. It thus appears that three distinct species were confounded under the name *C. fauriei*: the long-racemed southern populations of *C. coriacea*, plants with slimmer twigs and smaller leaves resembling *C. hardyi*, and a plant with the smallest flowers in the genus.

In order to determine which of these takes the name *C. fauriei*, it was first necessary to clarify the typification of that name. In the protologue, L  veill   cited two gatherings: “Kauai: Koloa; Waimea, 1000 m, dec. 1909, mart. 1910, (Faurie, 565, 591).” These are thus syntypes from which a lectotype must be selected. Rock (1913, 1914, 1919) apparently only saw *Faurie 565*, but never referred to it as the type. Wimmer (1943) saw both gatherings and specifically excluded *Faurie 591* from *C. coriacea* var. *fauriei* by referring it to *C. coriacea* var. *hardyi* (Rock) E. Wimmer, a homotypic synonym of *C. hardyi*. Like Rock, he did not specifically state that *Faurie 565* was the type of *C. fauriei*. As a result, neither action can be interpreted as an effective lectotypification under Article 7.11 of the ICBN (Greuter et al., 2000).

The specimens upon which L  veill   based his new taxa were deposited in his personal herbarium, which was sold to E in 1919 (Stafleu & Cowan, 1979). Staff members of that institution have compiled a catalogue of all names ever published by L  veill  , together with information on typification (cf. Lauener, 1983). In this catalogue, every one of the Hawaiian Lobelioideae is listed as “typus—n[on]. v[er]i[di].,” even though types for nearly all Chinese Campanulaceae were seen (Chamberlain, 1977). Indeed, when I requested a loan of L  veill  ’s Hawaiian lobelioid types from E in 1985, I received only a set of photographs showing specimens at BM, and a note stating that no actual specimens were to be found at E. Lauener (1980) referred to the specimens at BM as isotypes (or syntypes, if two or more numbers had been cited in the protologue), but they appear to be the original specimens from L  veill  ’s personal herbarium. I have been unable to discover why these specimens are at BM and not E with the remainder of L  veill  ’s personal herbarium.

In any event, both *Faurie 565* and *Faurie 591* were found at BM, each represented by a photograph at E. As noted by Wimmer (1943), the latter gathering does not conform to the original diagnosis of *C. fauriei* and is referable to *C. hardyi*. For this

reason, *C. fauriei* is here lectotypified on the basis of *Faurie* 565, which does conform to the diagnosis. Because this specimen represents the long-racemed southern populations of *C. coriacea*, this binomial is here treated as a synonym of *C. coriacea* (following Rock, 1913, 1914), along with several varieties of that species that do not merit recognition (cf. Lammers, 1990a). All are listed here for clarity.

Cyanea coriacea (A. Gray) Hillebrand, Fl. Hawaiian Isl. 254. 1888. *Delissea coriacea* A. Gray, Proc. Amer. Acad. Arts 5: 147. 1861. TYPE: U.S.A. Hawaiian Islands: Kaua'i, 1851–1855, *J. Rémy* 302 (holotype, GH; isotypes, A, L, P[5], Z).

Cyanea fauriei H. Léveillé, Repert. Spec. Nov. Regni Veg. 10: 156. 1911. *Cyanea coriacea* var. *fauriei* (H. Léveillé) E. Wimmer, Pflanzenr. IV.276b: 72. 1943. *Delissea fauriei* (H. Léveillé) H. St. John, Phytologia 63: 342. 1987; non H. Léveillé, Repert. Spec. Nov. Regni Veg. 12: 505. 1913. TYPE: U.S.A. Hawaiian Islands: Kaua'i, Kōloa, Dec. 1909, *U. Faurie* 565 (lectotype, selected here, BM, photograph, E; isolecotypes, A, BISH, G, P, W).

Cyanea coriacea var. *degeneriana* E. Wimmer, Pflanzenr. IV.276b: 761. 1953. *Delissea coriacea* var. *degeneriana* (E. Wimmer) H. St. John, Phytologia 63: 82. 1987. TYPE: U.S.A. Hawaiian Islands: Kaua'i, ridge behind Pāpa'a, 16 Jan. 1952, *O. Degener* & *A. Greenwell* 21736a (holotype, W; isotypes, B[2]).

Delissea coriacea var. *deltoidea* H. St. John, Phytologia 63: 340. 1987. Syn. nov. *Delissea perlmanii* H. St. John, Phytologia 63: 346. 1987 (as 'perlmannii'). TYPE: U.S.A. Hawaiian Islands: Kaua'i, Limahuli Valley, common, 8 Sep. 1977, *S. Perlman* 1 (holotype, BISH; isotypes, BISH[2]).

Delissea coriacea var. *haupuensis* H. St. John, Phytologia 63: 340. 1987. Syn. nov. TYPE: U.S.A. Hawaiian Islands: Kaua'i, Hoary Head Range, near 1286 ft. peak N of Lā'aukahi, E side of range, dryland forest, 1100 ft., 3 Nov. 1976, *C. Christensen* 91 (holotype, BISH; isotype, BISH).

Delissea coriacea var. *lumahaiensis* H. St. John, Phytologia 63: 340. 1987. TYPE: U.S.A. Hawaiian Islands: Kaua'i, road between Hanalei & Lumaha'i, Sep. 1913, *C. N. Forbes* & *H. J. Forbes* 464.K (holotype, BISH; isotypes, BISH, GB, K, NY, P, UC, US).

The two sets of populations that were formerly identified as *C. fauriei* but are not referable to *C. coriacea* are described here as new species. Though no names at species rank are available, a name at the rank of *forma* is referable to one species as here circumscribed. However, I explicitly decline to take up this epithet. Though its type falls within the circumscription of the species, its original description does not address the characters emphasized here. For the sake of clarity and precision, I prefer to exercise my prerogative and treat the species as new, with its own diagnosis.

Cyanea pseudofauriei Lammers, sp. nov. TYPE: U.S.A. Hawaiian Islands: Kaua'i, Kōloa District, Līhu'e-Kōloa Forest Reserve, along ridge ESE of Pu'u Kolo, lower ridge in diverse forest with rather stunted vegetation on the windward slopes of the ridge, common on windward slope, elev. 1200–1700 ft., 21 Sep. 1988, *T. Flynn*, *G. Kawakami* & *R. Nagata* 3144 (holotype, F; isotype, PTBG). Figure 4A, B.

Cyanea coriacea f. *gratiosa* E. Wimmer, Pflanzenr. IV.276b: 760. 1953. *Delissea coriacea* var. *gratiosa* (E. Wimmer) H. St. John, Phytologia 63: 82. 1987. TYPE: U.S.A. Hawaiian Islands: Kaua'i, ridge behind Pāpa'a, Moloka'a Forest Reserve, 16 Jan. 1952, *O. Degener* & *A. Greenwell* 21737 (lectotype, selected here, B; isolecotype, W).

The protologue of *Cyanea coriacea* f. *gratiosa* cited "Kauai: Ridges behind Papaa in lower forest, 16. I. 1952 (Hb. Deg. n. 21736! common form, 21737! rare form intermediate in coloration betw. n. 21736 and n. 21738)." I have seen sheets of *Degener* & *Greenwell* 21737 at B and W, of which the former was annotated "Holotypus" by Wimmer; and sheets of *Degener* & *Greenwell* 21736 at B and BISH, both of which were annotated "Paratypus" by Wimmer. In accordance with Recommendation 9A.3 of the ICBN (Greuter et al., 2000), the B sheet of the former is designated as the lectotype.

Species affinis *Cyaneae coriaceae* et *C. hardyi*, sed caulibus 0.7–1.1 cm diametro apicem versus, lamina 11.5–24.5 cm longa 2.8–5.5 cm lata anguste elliptica vel oblanceolata basi cuneata, pedunculo 20–75 mm longo, rhachidi 8–40 mm longa, hypanthio 3–5 mm longo late ellipsoidali vel hemisphaerico, calycis lobis 0.3–0.8 mm longis 0.3–0.4 mm latis, corollae tubo 3.5–4 mm diametro basi 2–2.5 mm diametro in medio, et tubo filamentorum 18–21 mm longo distinguenda.

Shrubs or treelets, 0.9–3.7 m tall; stems unbranched or sparingly branched, 0.7–1.1 cm diam. at apex, glabrous; pith chambered; latex white. Lamina narrowly elliptic or oblanceolate, 11.5–24.5 × 2.8–5.5 cm; upper surface light green, glabrous; lower surface whitish green, pubescent along the midrib or nearly glabrous; margin crenulate; apex obtuse or acute; base cuneate; petiole 2.5–11 cm long, 1.2–2.5 mm diam., $\frac{1}{5}$ – $\frac{1}{2}$ as long as the lamina, glabrous. Racemes 9- to 30-flowered; peduncle ascending when short, decurved when long, 20–75 mm long, 0.8–1.2 mm diam., glabrous; rachis 8–40 mm long, glabrous; bracts triangular or deltate, 0.7–1.4 × 0.7–1 mm, pubescent, deciduous, subtending the pedicels, acute or acuminate at apex; pedicels ascending, 9–14 mm long, 0.3–0.6 mm diam., glabrous, bibracteolate at a point $\frac{1}{3}$ – $\frac{1}{2}$ the distance above the base; bracteoles linear, 0.5–



Figure 4. Species of *Cyanea* sect. *Delisseoideae*. —A, B. *Cyanea pseudofauriei* Lammers. —A. Twig. —B. Flower. (Drawn from the holotype, Flynn et al. 3144.) —C. *Cyanea minutiflora* Lammers, flower. (Drawn from the holotype, Forbes 568.K.)

0.8 × 0.1–0.2 mm, pubescent, acuminate at apex. Hypanthium broadly ellipsoid or hemispherical, 3–5 mm long, 3–4.7 mm diam., $\frac{1}{7}$ – $\frac{1}{5}$ as long as the corolla, glabrous; calyx lobes triangular or deltate, 0.3–0.8 × 0.3–0.4 mm, pubescent, acuminate at apex; corolla white tinged with purple at base, or more heavily striped or suffused with dark purple, 25–31 mm long, glabrous; corolla tube suberect, 13–19 mm long, 3.5–4 mm diam. at base, gradually

narrowing to 2–2.5 mm diam. at middle, then increasing to 2.8–4.5 mm diam. at mouth; dorsal corolla lobes linear triangular, 10–14 × 1–1.3 mm, $\frac{1}{2}$ as long to a little longer than the tube, acuminate at apex; ventral corolla lobes linear triangular, 8–11 × 0.9–1.2 mm, connate at base for 2–4.5 mm, acuminate at apex; staminal column exerted, emerging from the corolla above or between the dorsal lobes; filament tube slightly downcurved,

18–21 mm long, 0.8–1.2 mm diam., glabrous; anther tube slightly downcurved, 1.7–2.2 mm diam., the surfaces glabrous; dorsal anthers 7–8 mm long, $\frac{1}{3}$ – $\frac{2}{5}$ as long as the filament tube; ventral anthers 5–6.5 mm long, with tufts of hairs 1.2–2.2 mm long at apex. Berries purple, globose, 6–8 mm long, 6–8 mm diam.; seeds orangish brown, ellipsoid, 0.8–1 mm long, 0.5–0.7 mm diam., the testa minutely papillose (Type F; Buss et al., 2001), shining.

Additional illustrations. Degener and Degener (1956), left side of plate [as *C. coriacea* f. *gratiosa*]; Buss et al. (2001), fig. 28 [seed only].

Distribution, habitat, and phenology. Endemic to Kaua'i in the Hawaiian Islands, growing in mesic forest at elevations of 165–640 m. Flowering September through December, the fruit beginning to ripen in December.

Etymology. The specific epithet refers to the fact that many specimens were previously identified as *Cyanea fauriei*; from the Latin prefix *pseudo-*, false, and the specific epithet.

Relationships. *Cyanea pseudofauriei* differs from *C. coriacea* (including *C. fauriei*) by its more slender twigs (0.7–1.1 vs. 1.4–2.5 cm diam.); laminae smaller (11.5–24.5 vs. 18–39 cm long, 2.8–5.5 vs. 5.5–11.2 cm wide) and narrowly elliptic or oblanceolate (vs. oblong or broadly elliptic); hypanthium broadly ellipsoid or hemispherical (vs. obovoid or campanulate); and its basally more slender corolla tube (3.5–4 vs. 4–5.5 mm diam.).

Some specimens referable to the new species were identified previously as *C. hardyi*. However, *C. pseudofauriei* differs from that species in its cuneate (vs. attenuate) leaf bases; shorter rachises (8–40 vs. 75–200 mm); shorter pedicels (9–14 vs. 13–22 mm); hypanthium shorter (3–5 vs. 5–6.5 mm) and broadly ellipsoid or hemispherical (vs. obconic or campanulate); shorter calyx lobes (0.3–0.8 vs. 1–1.2 mm); corolla tube more slender (3.5–4 vs. 4.5–5.8 mm diam. at base, 2–2.5 vs. 2.7–4.2 mm diam. at middle); and shorter filament tube (18–21 vs. 20–27 mm). In addition, the mean lengths of both petioles and racemes in *C. pseudofauriei* are significantly less than in the other two species, though there is considerable overlap in the ranges of variation.

These three species are largely sympatric, growing at elevations below 680 m. *Cyanea pseudofauriei* and *C. hardyi* have largely non-overlapping phenologies: the former flowers from September to December, the latter from November to April. *Cyanea coriacea*, however, overlaps both, flowering from late July through January.

Paratypes. U.S.A. Hawaiian Islands. Kaua'i. **Hana-**

lei: rear of Waipā, Hume & Flynn 366 (F, PTBG); Hanakāpī'ai, St. John et al. 10913 (BISH, W); Limahuli V., Wichman 200 (PTBG). **Kawaihau:** Anahola, Degener & Ordóñez 12831 (A, NY); ridge behind Pāpa'a, Degener & Greenwell 21736 (B, BISH). **Līhu'e:** Kīpū, Hā'upu, St. John & Fosberg 13654 (BISH, BM, K, POM). **Koloa:** Kaluaalea, Degener & Ordóñez 12832 (F); ridge ESE of Pu'u Kolo, Flynn et al. 3143 (PTBG), Flynn et al. 3150 (F, PTBG); jeep trail to Wahiawa Bog, Herbst 2095 (BISH, PTBG); ridge ESE of Pu'u Kolo, Lorence & Flynn 6284 (MO, PTBG); road to Wahiawa Bog, Stern & Carlquist 1338 (RSA, US); Lā'aūkahi, St. John & Fosberg 13455 (BISH); peak $\frac{1}{2}$ mi. N of Lā'aūkahi, St. John et al. 22990 (BISH, NY [seed voucher]); $\frac{3}{4}$ mi. N of Lā'aūkahi, St. John et al. 23026 (BISH); N of Wahiawa Bog, St. John & Ehrendorfer 26767 (BISH).

Cyanea minutiflora Lammers, sp. nov. TYPE: U.S.A. Hawaiian Islands: Kaua'i, mts. near Ka Loko Reservoir (Kilauea), 10 Oct. 1916, C. N. Forbes 568.K (holotype, BISH; isotypes, BISH, MO, RSA). Figure 4C.

Haec species a speciebus omnis aliis *Cyaneae* corolla minimis 15–16.5 mm longa differt.

Stems 0.8–0.9 cm diam. near apex, glabrous; pith chambered. Lamina oblong, 12.5–17 × 3.5–4.2 cm; upper surface green, glabrous; lower surface light green, glabrous; margin callose-crenulate; apex acuminate or cuspidate; base obtuse; petiole 5–10 cm long, 1.7–2 mm diam., $\frac{2}{5}$ – $\frac{2}{3}$ as long as the lamina, glabrous. Racemes 30- to 40-flowered over their life, but only a few open at any one time; peduncle ascending, 35–50 mm long, 1.3–1.7 mm diam., glabrous; rachis 12–25 mm long, glabrous; bracts triangular, 1 × 0.5 mm, subtending the pedicels, deciduous, pubescent, acuminate at apex; pedicels ascending, 5–11 mm long, 0.3–0.5 mm diam., bibracteolate at about the middle, glabrous; bracteoles linear, 0.4–0.6 × 0.1–0.2 mm, acuminate at apex. Hypanthium globose or broadly elliptic, 2.3–2.7 mm long, 2.8–3 mm diam., $\frac{1}{7}$ – $\frac{1}{6}$ as long as the corolla, glabrous; calyx lobes triangular or deltate, 0.3–0.4 × 0.3–0.4 mm, pubescent, acuminate at apex; corolla 15–16.5 mm long, glabrous; corolla tube gently curved, 9–10 mm long, 2.4–2.5 mm diam. at base, gradually narrowing to 1.2–1.4 mm diam. at middle, then increasing to 2.2–2.8 mm diam. at mouth; dorsal corolla lobes linear triangular, 6–7.5 × 0.8–1 mm, $\frac{3}{5}$ – $\frac{4}{5}$ as long as the tube, acuminate at apex; ventral corolla lobes narrowly triangular, 5–6 × 1–1.2 mm, acuminate at apex; staminal column slightly exerted, emerging from the corolla between the dorsal lobes; filament tube slightly decurved, 12–14 mm long, 0.4–0.7 mm diam., glabrous; anther tube slightly decurved 1.5–1.8 mm diam., the surfaces glabrous; dorsal anthers 4.5–5 mm long, $\frac{1}{3}$ – $\frac{2}{5}$ as long as the filaments; ven-

tral anthers 3–3.5 mm long, with tufts of hairs 0.9–1.1 mm long at apex. Mature fruit and seeds not seen.

Distribution, habitat, and phenology. Endemic to northeastern Kauaʻi in the Hawaiian Islands, and known only from the type. Flowering in October.

Etymology. The specific epithet refers to the small flowers, the smallest known in the genus; a compound adjective, from Latin *minutus*, very small, and *flos*, flower.

Relationships. As noted above, a single specimen previously identified as *C. fauriei* differs from *C. pseudofauriei* in a number of features. This plant had oblong laminas (vs. narrowly elliptic or oblanceolate) acuminate or cuspidate at apex (vs. obtuse or acute); peduncles that are thicker (1.3–1.7 vs. 0.8–1.2 mm diam.) and ascending (vs. often decurved); smaller hypanthium (2.3–2.7 vs. 3–5 mm long, 2.8–3 vs. 3–4.7 mm diam.); shorter corolla (15–16.5 vs. 25–31 mm); shorter filament tube (12–14 vs. 18–21 mm); and shorter anthers (dorsal, 4.5–5 vs. 7–8 mm; ventral, 3–3.5 vs. 5–6.5 mm). It is these floral measurements that are especially significant, as this plant has by far the smallest flowers in the entire genus. In only two other species do the flowers even begin to approach the diminutiveness of *C. minutiflora*: *C. elliptica* (Rock) Lammers and *C. kahiliensis* (H. St. John) Lammers.

Cyanea elliptica occurs on Maui, Lānaʻi, and Mo-

lokaʻi, geologically younger islands well east of Kauaʻi. It differs from *C. minutiflora* by the obtuse or acute apex of the lamina; fewer-flowered racemes (6 to 14 vs. 30 to 40 flowers each); shorter peduncles (10–35 vs. 35–50 mm); more basally inserted bracteoles (at a point $\frac{1}{8}$ – $\frac{1}{3}$ the distance from the base vs. at the middle); longer corolla (17–29 vs. 15–16.5 mm); and a longer filament tube (16–18 vs. 12–14 mm).

Cyanea kahiliensis (H. St. John) Lammers is endemic to southern and eastern Kauaʻi, south of the only known locality of *C. minutiflora*. It differs from *C. minutiflora* by its laminas narrowly elliptic or narrowly oblong (vs. oblong) and cuneate at base (vs. obtuse); more slender petioles (1–1.7 vs. 1.7–2 mm diam.); fewer-flowered racemes (8 to 10 vs. 30 to 40 flowers each), larger hypanthium (4–5 vs. 2.3–2.7 mm long, 3–4 vs. 2.8–3 mm diam.), longer corolla (19–25 vs. 15–16.5 mm); and longer anthers (dorsal, 5.2–6 vs. 4.5–5 mm; ventral, 4.3–4.8 vs. 3–3.5 mm).

The following key may be used to distinguish the 15 species now assigned to *Cyanea* sect. *Delisseoideae*, including *C. minutiflora* and *C. pseudofauriei*. It cannot be inserted smoothly into the existing key for the genus (Lammers, 1990a), because *C. asarifolia* and *C. linearifolia* key out there in couplets 8 and 9 (p. 440), respectively, while the remaining species appear in couplets 26–32 (pp. 441–442).

KEY TO THE SPECIES OF HAWAIIAN *CYANEA* SECT. *DELISSEOIDEAE*

- 1a. Lamina less than 3 times longer than wide, cordate or subcordate at base; petiole $1\frac{1}{4}$ – $2\frac{1}{4}$ times as long as the lamina.
 - 2a. Margin of the lamina callose-serrulate; inflorescences 8- to 11-flowered; peduncle 40–45 mm long; rachis 20–27 mm long; bracts 5–7 mm long; bracteoles 7.5–8 mm long, at or near the middle of the pedicel (Kauaʻi) *C. dolichopoda*
 - 2b. Margin of the lamina callose-crenulate; inflorescences 20- to 40-flowered; peduncle 20–35 mm long; rachis 60–70 mm long; bracts 1–1.6 mm long; bracteoles 0.9–1.2 mm long, at a point $\frac{1}{4}$ – $\frac{1}{3}$ the distance from the base of the pedicel (Kauaʻi) *C. asarifolia*
- 1b. Lamina (2.5–)4–36 times longer than wide, attenuate, cuneate, obtuse, or rounded at base; petiole shorter than the lamina or rarely about as long.
 - 3a. Dorsal anthers 6.5–9.5 mm long.
 - 4a. Calyx lobes $3\text{--}5 \times 1.7\text{--}3$ mm (Molokaʻi) *C. mannii*
 - 4b. Calyx lobes $0.3\text{--}3.2 \times 0.3\text{--}1.8$ mm.
 - 5a. Bracts linear or linear triangular, 1.8–3.3 mm long; pedicels bibracteolate just above the base (Waiʻanae Mts. of Oʻahu) *C. membranacea*
 - 5b. Bracts triangular, widely deltate, or deltate, 0.8–1.7 mm long; pedicels bibracteolate at a point $\frac{1}{5}$ – $\frac{1}{2}$ the distance above the base.
 - 6a. Dorsal surface of lamina, petiole, peduncle, rachis, pedicels, hypanthium, and corolla pubescent; calyx lobes 1.5–3.2 mm long; corolla 1.8–2 mm diam. at middle; ventral corolla lobes connate 9–10 mm at base (Maui) *C. obtusa*
 - 6b. Dorsal surface of lamina, petiole, peduncle, rachis, pedicels, hypanthium, and corolla glabrous; calyx lobes 0.3–1.2 mm long; corolla 2–4.2 mm diam. at middle; ventral corolla lobes connate 1–5 mm at base (Kauaʻi).
 - 7a. Stems 1.4–2.5 cm diam. near apex; lamina oblong, 5.5–11.2 cm wide *C. coriacea*
 - 7b. Stems 0.7–1.3 cm diam. near apex; lamina oblanceolate or narrowly elliptic, 2.5–5.5 cm wide.
 - 8a. Lamina cuneate at base; rachis 8–40 mm long; pedicels 9–14 mm long;

- hypanthium broadly ellipsoid or hemispherical, 3–5 mm long; calyx lobes 0.3–0.8 × 0.3–0.4 mm; corolla tube 3.5–4 mm diam. at base, narrowing to 2–2.5 mm diam. at middle; filament tube 18–21 mm long *C. pseudofauriei*
- 8b. Lamina attenuate at base; rachis 75–200 mm long; pedicels 13–22 mm long; hypanthium obconic or campanulate, 5–6.5 mm long; calyx lobes 1–1.2 × 0.5–1.2 mm wide; corolla tube 4.5–5.8 mm diam. at base, narrowing to 2.7–4.2 mm diam. at middle; filament tube 20–27 mm long . . . *C. hardyi*
- 3b. Dorsal anthers 4–6.2 mm long.
- 9a. Lamina linear, 0.3–1.3 cm wide, 20–36 times longer than wide (Kaua'i) *C. linearifolia*
- 9b. Lamina oblong, narrowly oblong, elliptic, narrowly elliptic, lanceolate, oblanceolate, 1–11.2 cm wide, 2.5–18 times longer than wide.
- 10a. Corolla 15–16.5 mm long (Kaua'i) *C. minutiflora*
- 10b. Corolla 17–30 mm long.
- 11a. Lamina elliptic or oblong, 2.5–4 times longer than wide, the base rounded or obtuse; bracts narrowly triangular or triangular, 1–2.5 mm long; bracteoles at a point $\frac{1}{8}$ – $\frac{1}{3}$ the distance above the base of the pedicel (Moloka'i, Lāna'i, Maui) *C. elliptica*
- 11b. Lamina lanceolate, oblanceolate, narrowly elliptic, or narrowly oblong, 4–18 times longer than wide, the base attenuate or cuneate (rarely obtuse); bracts deltate or shallowly deltate (rarely triangular), 0.6–0.9 mm long; bracteoles at a point $\frac{1}{3}$ – $\frac{1}{2}$ the distance above the base of the pedicel.
- 12a. Pedicels 6–8 mm long; hypanthium broadly obovoid; dorsal corolla lobes 15 × 1.7 mm (Kaua'i) *C. habenata*
- 12b. Pedicels 8–30 mm long; hypanthium obovoid, obconic, or hemispheric; dorsal corolla lobes 8–14 × 0.5–1.5 mm.
- 13a. Pith solid; leaf margin commonly revolute; bracteoles widely deltate, triangular, or narrowly triangular, 0.3–0.5 mm long; ventral anthers 3–3.5 mm long (Kaua'i) *C. spathulata*
- 13b. Pith chambered, starting about 8 cm below the apex; leaf margin flat; bracteoles linear or linear triangular, 0.5–0.9 mm long; ventral anthers 4–5.7 mm long.
- 14a. Petiole $\frac{1}{2}$ as long to about as long as the lamina; rachis 4–14 mm long; corolla tube dorsally cleft for $\frac{1}{5}$ – $\frac{1}{2}$ its length; ventral corolla lobes 5–8 mm long, connate basally for 2–4 mm (Kaua'i) *C. kahiliensis*
- 14b. Petiole $\frac{1}{5}$ – $\frac{3}{5}$ as long as the lamina; rachis 10–320 mm long; corolla tube dorsally cleft for $\frac{1}{2}$ – $\frac{2}{3}$ its length; ventral corolla lobes 8–18 mm long, connate basally for 5–12 mm (O'ahu, Lāna'i, West Maui) *C. angustifolia*

Acknowledgments. My sincerest appreciation is extended to Hank Oppenheimer of the Maui Pineapple Co., Lahaina, for communicating with me his group's discoveries on East Maui. Not only did Hank forward to me all their collections, notes, and photographs, but he repeatedly revisited the site at my behest to answer questions posed by me subsequently. I also thank University of Wisconsin Oshkosh graduate student Yvette Evrard for skillfully preparing the line drawings of each species. This research benefited greatly from the examination of specimens deposited at A, B, BM, E, F, G, GB, GH, K, L, MO, NY, OS, P, POM, RSA, S, UC, US, W, Z, and most especially the exemplary collections at BISH and PTBG; I thank the administration and staff of each for making this material available to me, either via loans or during visits.

Literature Cited

- Batterman, M. R. W. & T. G. Lammers. In press. Branched foliar trichomes of Lobelioideae (Campanulaceae) and the infrageneric classification of *Centropogon*. Syst. Bot.
- Buss, C. C., T. G. Lammers & R. R. Wise. 2001. Seed coat morphology and its systematic implications in *Cyanea* and other genera of Lobelioideae (Campanulaceae). Amer. J. Bot. 88: 1301–1308.
- Carlquist, S. 1974. Island Biology. Columbia Univ. Press, New York.
- Chamberlain, D. F. 1977. Catalogue of the names published by Hector Léveillé: X. Notes Roy. Bot. Gard. Edinburgh 35: 247–264.
- Degener, O. & I. Degener. 1956. Flora Hawaiiensis, Family 339, *Cyanea coriacea*. Published privately, Honolulu.
- Givnish, T. J., K. J. Sytsma, J. F. Smith & W. J. Hahn. 1994. Thorn-like prickles and heterophylly in *Cyanea*: Adaptations to extinct avian browsers on Hawaii? Proc. Natl. Acad. Sci. U.S.A. 91: 2810–2814.
- , ———, ——— & ———. 1995. Molecular evolution, adaptive radiation, and geographic speciation in *Cyanea* (Campanulaceae, Lobelioideae). Pp. 288–337 in W. L. Wagner & V. A. Funk (editors), Hawaiian Biogeography: Evolution on a Hot Spot Archipelago. Smithsonian Institution Press, Washington, DC.
- Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. D. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawks-

- worth (editors). 2000. International Code of Botanical Nomenclature (St. Louis Code). Regnum Veg. 138.
- Hillebrand, W. 1888. Flora of the Hawaiian Islands. Williams & Norgate, London.
- Lammers, T. G. 1990a. Campanulaceae. Pp. 420–489 in W. L. Wagner, D. R. Herbst & S. H. Sohmer, Manual of the Flowering Plants of Hawai'i. Univ. Hawai'i Press, Honolulu.
- . 1990b. Sequential paedomorphosis among the endemic Hawaiian Lobelioideae (Campanulaceae). Taxon 39: 206–211.
- . 1991. Systematics of *Clermontia* (Campanulaceae: Lobelioideae). Syst. Bot. Monogr. 32: 1–97.
- . 1992. Two new combinations in the endemic Hawaiian genus *Cyanea* (Campanulaceae: Lobelioideae). Novon 2: 129–131.
- . 1994. Typification of the names of Hawaiian Lobelioideae (Campanulaceae) published by Wilhelm Hillebrand or based upon his specimens. Taxon 43: 545–572.
- . 1996. A new linear-leaved *Cyanea* (Campanulaceae: Lobelioideae) from Kaua'i, and the "rediscovery" of *Cyanea linearifolia*. Brittonia 48: 237–240.
- . 1998a. New names and new combinations in Campanulaceae. Novon 8: 31–35.
- . 1998b. Review of the Neotropical endemics *Burmeistera*, *Centropogon*, and *Siphocampylus* (Campanulaceae: Lobelioideae), with description of 18 new species and a new section. Brittonia 50: 233–262.
- . 1999. A new *Lobelia* from Mexico, with additional new combinations in world Campanulaceae. Novon 9: 381–389.
- . 2002. Seventeen new species of Lobelioideae (Campanulaceae) from South America. Novon 12: 206–233.
- , T. J. Givnish & K. J. Sytsma. 1993. Merger of the endemic Hawaiian genera *Cyanea* and *Rollandia* (Campanulaceae: Lobelioideae). Novon 3: 437–441.
- & D. H. Lorence. 1993. A new species of *Cyanea* (Campanulaceae: Lobelioideae) from Kaua'i, and the resurrection of *C. remyi*. Novon 3: 431–436.
- Lauener, L. A. 1980. Faurie's Hawaiian types at the British Museum. Notes Roy. Bot. Gard. Edinburgh 38: 495–497.
- . 1983. Catalogue of the names published by Hector Léveillé: Index. Notes Roy. Bot. Gard. Edinburgh 41: 339–393.
- Murata, J. 1992. Systematic implications of seed coat morphology in *Lobelia* (Campanulaceae–Lobelioideae). J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 15: 155–172.
- . 1995. A revision of infrageneric classification of *Lobelia* (Campanulaceae–Lobelioideae) with special reference to seed coat morphology. J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 15: 349–371.
- Rock, J. F. 1913. Remarks on certain Hawaiian plants described by H. Léveillé in Fedde Repertorium X. 10/14 (1911) 156–157. Coll. Hawaii Publ. Bull. 2: 48–49.
- . 1914. Revisio plantarum Hawaiiensium a Léveillé descriptarum. Repert. Spec. Nov. Regni Veg. 13: 352–361.
- . 1917. Notes on Hawaiian Lobelioideae, with descriptions of new species and varieties. Bull. Torrey Bot. Club 44: 229–239 + pl. 9–16.
- . 1919. A monographic study of the Hawaiian species of the tribe Lobelioideae family Campanulaceae. Mem. Bernice Pauahi Bishop Mus. 7(2): i–xvi, 1–395.
- Stafleu, F. A. & R. S. Cowan. 1979. Taxonomic Literature, ed. 2, vol. 2. Bohn, Scheltema & Holkema, Utrecht.
- St. John, H. 1969. Types of sections in *Clermontia*, *Cyanea*, and *Delissea* (Lobeliaceae). Taxon 18: 483.
- . 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Pacific Tropical Botanical Garden, Lāwā'i.
- . 1980. Evaluation of H. Léveillé's new Hawaiian species. Hawaiian plant studies 76. Phytologia 45: 289–294.
- Wimmer, F. E. 1943. Campanulaceae–Lobelioideae. I. Teil. Pp. i–vi, 1–260 in R. Mansfeld (editor), Das Pflanzenreich, IV.276b. Wilhelm Engelmann, Leipzig.